

The QuikSCAT Wind Scatterometer Mission

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FINAL

ABSTRACT

In June 1997, the NASA Scatterometer (NSCAT) ceased to operate due to a power failure aboard the ADEOS-I host spacecraft. This created an extensive gap in the Ku-Band scatterometer wind data base because the SeaWinds scatterometer, the follow-on to NSCAT, was not scheduled to be launched on ADEOS-II for several years. In order to resume the flow of scientifically important ocean surface wind data as quickly as possible, an innovative approach was developed. The SeaWinds flight spare hardware would be integrated with a small satellite bus and launched within a year's time. This mission would fill the gap in data until such time as the originally planned SeaWinds instrument could be launched. NASA's Rapid Spacecraft Acquisition program was used to purchase a small satellite bus, and the new mission was dubbed "QuikSCAT." On June 19, 1999, two years after NSCAT failed and two and a half years before ADEOS-II was expected to fly, QuikSCAT was successfully launched from Vandenberg Air Force Base into orbit via a Titan-II booster.

As with all wind scatterometers, SeaWinds obtains an estimate of the wind vector by measuring ocean surface radar backscatter cross section at multiple azimuth angles. The geophysical model function, which relates wind speed and direction to backscatter cross section, is then numerically inverted to infer the near surface wind. In a significant design departure from previously flown "fan-beam" scatterometer systems, SeaWinds has a "pencil-beam" design.

With fan-beam scatterometers, such as SASS, NSCAT, and the AMI scatterometer on the European Earth Remote Sensing satellite series (ERS-1 and 2), several fixed antennas are deployed to cast long, narrow illumination patterns at the multiple azimuth angles required for wind retrieval. The narrow dimension of the antenna beam pattern provides resolution in the along-track direction, and Doppler or range filtering is employed to provide cross-track resolution. The antenna structures are typically about three meters in length and require large unobstructed fields of view on the spacecraft.

By contrast, pencil-beam systems employ a single, approximately one meter parabolic dish which is conically scanned about the nadir axis to provide multiple azimuth measurements. A key advantage of pencil-beam systems is that, because of their more compact design, they are much easier to accommodate on spacecraft without requiring complex deployment schemes or imposing severe field-of-view constraints. In an era where smaller space missions with faster development times are often mandated -- as is the case with the QuikSCAT mission, for example -- such a reduction in payload size is highly desirable. An additional advantage to pencil-beam systems is that there is no ground track gap in swath coverage as there is for fan-beam systems. The resulting contiguous swath offers a significant improvement in Earth coverage.

In this paper, the QuikSCAT mission is described in detail. The unique aspects, advantages, and performance of the SeaWinds pencil-beam scatterometer instrument are also discussed.